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Rooflights 0.9x	1	x	8.7	x	157	x	0.76	x	0.8	=	747.42	(82)
Rooflights 0.9x	1	x	27	x	115	x	0.76	x	0.8	=	1699.06	(82)
Rooflights 0.9x	1	x	25	x	115	x	0.76	x	0.8	=	1573.2	(82)
Rooflights 0.9x	1	x	5.4	x	115	x	0.76	x	0.8	=	339.81	(82)
Rooflights 0.9x	1	x	8.7	x	115	x	0.76	x	0.8	=	547.47	(82)
Rooflights 0.9x	1	x	27	x	66	x	0.76	x	0.8	=	975.11	(82)
Rooflights 0.9x	1	x	25	x	66	x	0.76	x	0.8	=	902.88	(82)
Rooflights 0.9x	1	x	5.4	x	66	x	0.76	x	0.8	=	195.02	(82)
Rooflights 0.9x	1	x	8.7	x	66	x	0.76	x	0.8	=	314.2	(82)
Rooflights 0.9x	1	x	27	x	33	x	0.76	x	0.8	=	487.56	(82)
Rooflights 0.9x	1	x	25	x	33	x	0.76	x	0.8	=	451.44	(82)
Rooflights 0.9x	1	x	5.4	x	33	x	0.76	x	0.8	=	97.51	(82)
Rooflights 0.9x	1	x	8.7	x	33	x	0.76	x	0.8	=	157.1	(82)
Rooflights 0.9x	1	x	27	x	21	x	0.76	x	0.8	=	310.26	(82)
Rooflights 0.9x	1	x	25	x	21	x	0.76	x	0.8	=	287.28	(82)
Rooflights 0.9x	1	x	5.4	x	21	x	0.76	x	0.8	=	62.05	(82)
Rooflights 0.9x	1	x	8.7	x	21	x	0.76	x	0.8	=	99.97	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m ...(82)m

(83)m=	4887.82	9213.77	14624.36	20945.09	25635.35	26299.04	25009.67	21451.95	16841.51	10760.14	6024.46	4068.49	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	8202.3	12499.03	17763.89	23860.55	28312.31	28778.16	27386.36	23865.04	19396.05	13539.15	9047.78	7285.29	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.72	0.57	0.65	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.81	19.07	19.5	20.1	20.58	20.88	20.96	20.94	20.67	20.01	19.32	18.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.5	19.51	19.52	19.56	19.57	19.61	19.61	19.62	19.59	19.57	19.55	19.53	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.94	0.82	0.6	0.41	0.49	0.82	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.62	17	17.64	18.52	19.17	19.53	19.6	19.6	19.32	18.4	17.4	16.65	(90)

fLA = Living area ÷ (4) = 0.07 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.77	17.14	17.76	18.63	19.26	19.62	19.69	19.68	19.41	18.51	17.53	16.79	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.77	17.14	17.76	18.63	19.26	19.62	19.69	19.68	19.41	18.51	17.53	16.79	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Utilisation factor for gains, hm:

(94)m=	1	1	0.98	0.93	0.81	0.61	0.42	0.49	0.81	0.97	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	8193.51	12439.85	17422.45	22153.21	22833.93	17428.31	11365.75	11795.51	15720.26	13194.74	9023.58	7280.5	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	51347.61	50067.43	45765.26	38183.09	29472.93	18874	11607.64	12254.1	20262.12	30830.44	41218.43	50460	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	32106.65	25285.74	21087.05	11541.51	4939.41	0	0	0	0	13120.96	23180.29	32125.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 163387.15 (98)

Space heating requirement in kWh/m²/year 69.73 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	35343.69	27823.76	28366.04	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.75	0.83	0.77	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	26643.53	23078.38	21800.08	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	31986.94	30444.62	26518.06	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	3847.25	5480.48	3510.18	0	0	0	0	

Total = Sum(104)$_{5...9}$ = 12837.91 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.31 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104)$_{5...9}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	296.38	422.21	270.42	0	0	0	0	

Total = Sum(107)$_{5...9}$ = 989.01 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.42 (108)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0.1 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 0.9 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 0.9 (204)

Efficiency of main space heating system 1 230 (206)

Efficiency of secondary/supplementary heating system, % 37 (208)

Cooling System Energy Efficiency Ratio 4.32 (209)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	32106.65	25285.74	21087.05	11541.51	4939.41	0	0	0	0	13120.96	23180.29	32125.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	12563.47	9894.42	8251.46	4516.24	1932.81	0	0	0	0	5134.29	9070.55	12570.86	
Total (kWh/year) =Sum(211)$_{1..5,10..12}$=													63934.1 (211)
Space heating fuel (secondary), kWh/month													
= {[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	8677.47	6833.98	5699.2	3119.33	1334.98	0	0	0	0	3546.2	6264.94	8682.58	
Total (kWh/year) =Sum(215)$_{1..5,10..12}$=													44158.69 (215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from water heater (calculated above)	402.06	355.13	374.76	338.43	333.45	300.53	291.08	316.02	314.4	350.81	367.82	393.22	
Efficiency of water heater													170 (216)
(217)m=	170	170	170	170	170	170	170	170	170	170	170	170	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	236.5	208.9	220.45	199.08	196.15	176.78	171.23	185.9	184.94	206.36	216.37	231.31	
Total = Sum(219a)$_{1..12}$ =													2433.95 (219)

Space cooling fuel, kWh/month.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(221)m = (107)m÷ (209)													
(221)m=	0	0	0	0	0	68.61	97.73	62.6	0	0	0	0	
Total = Sum(221)$_{6..8}$ =													228.94 (221)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		63934.1
Space heating fuel used, secondary		44158.69
Water heating fuel used		2433.95
Space cooling fuel used		228.94
Electricity for pumps, fans and electric keep-hot		
mechanical ventilation - balanced, extract or positive input from outside	16199.65	(230a)
central heating pump:	120	(230c)
Total electricity for the above, kWh/year sum of (230a)...(230g) =		16319.65 (231)
Electricity for lighting		3174.46 (232)
Electricity generated by PVs		-7772.58 (233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year
Space heating - main system 1	(211) x	13.19 x 0.01 =	8432.91 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	4.23 x 0.01 =	1867.91 (242)